

**EXPLOSIVES SAFETY SUBMISSION
TOURTELOT PROJECT SITE
SOLANO COUNTY
BENICIA, CALIFORNIA**

1.0 INTRODUCTION

This Explosives Safety Submission (ESS) describes the methods and procedures to be used to locate and remove ordnance and explosives (OE). Location and removal of OE is one of the actions in response to the Order.

An engineering evaluation/cost analysis (EE/CA) for the former Benicia Arsenal, which includes the Project Site, was completed by the U.S. Army Corps of Engineers (USACE) in March 2000.

The former Benicia Arsenal EE/CA investigation divided the arsenal into five sectors for purposes of evaluation. These sectors are shown on Figure C-3. The Tourtelot Project Remediation, addressed by this submission, includes Sectors 3A and 3B, as well as areas to the west and south (see Figure C-3). Sectors 3A and 3B were determined during the EE/CA investigation to require a clearance to depth and were determined as deserving of removal actions by the Action Memorandum. This submission does not address Sectors 1, 2, 3C, 4, and 5. For purposes of this remediation, the Project Site has been divided into two sectors (Figure C-4) similar to Sectors 3A and 3B. An Action Memorandum was signed on March 30, 2000, by the Commander of USACE, Sacramento District.

An Imminent and/or Substantial Endangerment Determination and Remedial Action Order (Docket No. I/SE 98/99-011), signed June 1, 1999 (the "Order"), was issued for the Tourtelot Remediation Project Site (Project Site), Benicia, California, by the California Environmental Protection Agency (Cal/EPA), Department of Toxic Substances Control (DTSC).

A final draft remedial investigation/feasibility study (RI/FS) report (June 2001) was prepared. Based on the results of the RI and analysis of alternatives in the FS, the report recommended Alternative 5A as the preferred remedial action. Alternative 5A is composed of three remedial steps, point clearance of OE, OE scrap, and metallic anomalies of the entire Project Site, remediation of chemically affected soils, and areawide OE clearance. OE point clearance includes surface clearance, geophysical investigation and mapping, removal and disposal of all detected anomalies, and a quality control (QC) scan of the entire site that includes the removal of any additional anomalies detected. The QC scan would be conducted over the entire Project Site. OE point clearance would be followed by remediation of chemically affected soils. Affected areas include the TNT Strips; the Flare Site; Demolition Site #3; and Stockpiles #1, #2, and #3 in the North Valley. TNT Strips soils would be treated prior to removal to ensure that TNT concentrations are less than 10 percent. The final remedial step would be areawide OE clearance.

Areawide clearance is the removal of soil that is suspected of containing OE below the depth of the previous OE cleanup activity or that is associated with an

1 outlier and is within a future residential area. The areawide clearance will
2 continue until two consecutive lifts of soil that do not contain OE or OE scrap are
3 removed and no deeper anomalies are detected. A lift of soil ranges from 12 to
4 18 inches in thickness.

5 6 **1.1 Site Location**

7
8 The Project Site is approximately 220 acres in size and much of this site is
9 situated within the former Benicia Arsenal. Figure C-1 presents a regional map
10 of the area with the general location of the former Benicia Arsenal and the
11 Project Site.

12
13 The Project Site is bordered by the Southampton residential development to the
14 west and south, industrial and commercial facilities to the east and south, and
15 open space to the north. Figure C-2 presents a site map of the Project Site and
16 illustrates the proximity of the site to residential, commercial, and recreational
17 areas.

18 19 **1.2 Site Description**

20
21 The Project Site is situated in a hilly area dominated by a central, east/west-
22 trending ridge (referred to in this ESS as the "Ridge"), which acts as a drainage
23 divide between a major drainage swale to the south, referred to as the South
24 Valley, and a smaller drainage swale to the north, referred to as the North
25 Valley. Project Site elevations range from approximately 60 feet to 300 feet
26 above mean sea level (MSL) in the South Valley and 110 feet to 260 feet above
27 MSL in the North Valley. The top of the Ridge, which was excavated as part of
28 previous grading activities, is approximately 230 feet above MSL toward the
29 east end and approximately 300 feet above MSL toward the west end.

30 31 **1.3 Site History**

32
33 The former Benicia Arsenal began as the Benicia Barracks in 1849. During its
34 existence, the former Benicia arsenal supplied arms and serviced weaponry
35 during the Civil War, the Spanish-American War, World Wars I and II, and the
36 Korean Conflict. The former Benicia Arsenal manufactured targets for seacoast,
37 field, and mobile artillery firing practice. Testing of 155-millimeter (mm) howitzers
38 was performed on the former Benicia Arsenal using two large concrete test
39 tunnels. In addition, the arsenal assembled powder charges and rapid-fire
40 ammunition and filled armor-piercing projectiles with high explosives (HEs). As
41 part of the Cold War build-up, the former Benicia arsenal reconditioned NIKE
42 guided missiles.

43
44 The previous military uses of the Project Site are depicted in Figure C-5.
45 2,4,6-TNT was laid out in strips (TNT Strips) along the hillside and may have
46 been burned. Approximately 3.5 acres in the North Valley were developed with
47 roads and structures where the accuracy of howitzer gun barrels was checked
48 (Howitzer

1 Test Facility). Ordnance was inspected and renovated, and primers were
2 destroyed in a “squirrel cage” (Ammunition Renovation/Primer Destruction Site).
3 There was also a disposal area referred to as the “North Valley Military Landfill” in
4 the North Valley. Part of the Ridge was reportedly used to dispose of aged, out-
5 of-service dynamite (Dynamite Burn Site).
6

7 In the South Valley, there was a Flare Site and three suspected demolition sites
8 (Demolition Sites #1, #2, and #3) (Demolition Site #2 is no longer considered to
9 have been used as a demolition site). The Flare Site was used to burn old, out-
10 of-service flares. Demolition activities generally consisted of placing various
11 amounts of out-of-service munitions in a “pit,” placing a countercharge on top of
12 the items, and detonating them.
13

14 All structures within the North Valley have been dismantled. Most of the building
15 construction debris and inert OE scrap was removed from the Project Site
16 during these activities. A large number of concrete-filled howitzer shells were
17 unearthed during the dismantling activities in 1996, particularly in the vicinity of
18 the test tunnels.
19

20 USACE conducted historical investigations of the former Benicia Arsenal,
21 including the Project Site, in 1994, 1996, and 1999 (the results of these historical
22 investigations are contained in the March 1994 Archives Search Reports, the
23 May 1997 Supplemental Archives Search Report, and the 1999 Records
24 Research Report). In addition, USACE performed an EE/CA investigation to
25 evaluate potential OE and assess safety risks at the former Benicia Arsenal.
26 The property owner conducted a geophysical survey in 1996 over the Project
27 Site, excluding the cut portion of the Ridge, the western portion of the South
28 Valley, and the wetland area in the South Valley to assess the distribution of
29 metallic anomalies. An additional geophysical survey of select areas throughout
30 the Project Site was conducted by USACE in 1999.
31

32 The geophysical surveys conducted identified anomalies at the Project Site.
33 The data collected from these surveys were used to perform OE clearances in
34 August and December 1996 and to support a USACE OE investigation of the
35 former Benicia Arsenal, including the Project Site and adjacent property, in
36 March 1999. In May 2000, an investigation of the North Valley Military Landfill
37 was conducted utilizing construction support for OE. Approximately one half of
38 the geophysical anomalies identified were OE-related scrap. No OE was
39 encountered.
40

41 As a result of previous clearances and investigations, a total of nine OE items
42 related to site activities have been recovered from the Project Site. Table C-1
43 lists the type and depth of the OE and the recovery date. Figure C-5 depicts the
44 location of each OE encountered. All nine items have been recovered from the
45 South Valley and from the south portion of the Ridge. No OE items have been
46 recovered from the North Valley or on the slopes of the North Valley. All OE and
47 OE scrap recovered from the Project Site, outside the demolition sites in the
48 South Valley, were recovered at depths less than 2 feet below ground surface
49 (bgs), except in two areas disturbed by previous grading activities. The absence
50

Table C-1. Summary of OE Found on the Tourtelot Property

Grid	Easting ^(a)	Northing ^(a)	Type	Description	Depth (inches)	Disposition	Date Found
NA ^(b)	6518714	1792353	OE	37mm HE projectile	unknown	Destroyed by Travis AFB EOD Unit	11/12/96
NA ^(b)	6518717	1792344	OE	76mm APHE round	unknown	Destroyed by Travis AFB EOD Unit	11/12/96
NA	6519242	1792111	OE	37mm HE projectile	unknown	Destroyed by Travis AFB EOD Unit	12/96
I-14	6519030	1792468	OE	40mm AA HE	12	Destroyed by Travis AFB EOD Unit	12/02/96
O-15	6520319	1792264	OE	60mm mortar, fuzed	2	Destroyed by Travis AFB EOD Unit	12/05/96
P-15	6520425	1792250	OE	40mm AA, unfired	8	Destroyed by Travis AFB EOD Unit	12/06/96
0312	6518714	1792342	OE	37mm HE projectile, fuzed	24	Destroyed on-site	02/23/99
0312	6518710	1792352	OE	75mm shrapnel HE projectile, unfuzed	6	Destroyed on-site	02/23/99
NA	6519085	1792150	OE	Expelling charge	surface	Destroyed by Travis AFB EOD Unit	05/06/99

Notes: (a) Easting and northing coordinates are estimated based on the location of the item within the sampling grid.

(b) Item found in EE/CA grid 0312, prior to the 1999 EE/CA investigation.

AA = anti-aircraft
 AFB = air force base
 APHE = armor-piercing, high explosive
 EOD = explosives and ordnance disposal
 HE = high explosive
 NA = not applicable
 OE = ordnance and explosives

of OE and OE scrap at depths greater than 2 feet bgs indicates that any OE at the Project Site is likely be buried at a shallow depth that is consistent with the historical use of the Project Site.

The Tourtelot OE Remediation Project will investigate, detect, identify, and remove OE, OE scrap, and non-OE metallic debris from the Project Site.

2.0 REASON FOR ORDNANCE AND EXPLOSIVES

OE has either been located or is suspected on the entire Project Site addressed by this submission due to past DOD activities at the former Benicia Arsenal. The known, or suspected, OE contamination within each sector was evaluated during past site studies. Table C-2 presents the reasons for OE for the Project Site to be addressed by this submission.

Table C-2. Reason for OE by Project Area

Project Site Area	Reason for OE
South Valley	The potential exists for the area to contain OE since the site is within range of kick-outs from the suspected former demolition areas (Demolition Sites 1 and 3).
North Valley	The potential exists for the area to contain OE since OE was handled in this area.
Demolition Site 1	The potential exists for the area to contain OE since the site may have been used to explosively destroy ordnance in the 1950s
Demolition Site 3	The potential exists for the area to contain OE since the site was used to explosively destroy ordnance in the 1950s
Flare Site	Debris found prior to the EE/CA investigation indicates that flares were disposed of at this area.
TNT Strips	TNT-affected soil at concentrations greater than 10 percent by weight was found while sampling the unvegetated TNT Strips during the remedial investigation.

EE/CA = environmental evaluation/cost analysis
OE = ordnance and explosives

3.0 AMOUNT AND TYPE OF ORDNANCE AND EXPLOSIVES

The expected amount(s) and type(s) of OE expected for the Project Site are presented in Table C-3. The OE density estimates are based upon data collected during surface and intrusive sampling during the EE/CA, and the expected OE for each area is based on historical research.

Table C-3. OE Density Estimates for the Former Benicia Arsenal

Investigative Area	Minimum Estimated OE Density (OE per Acre)	Maximum Estimated OE Density (OE per acre)	Types of OE Expected
North Valley ^(a)	0.02	0.41	60mm mortar 40mm anti-aircraft HE
South Valley ^(b)	0.13	5.55	37mm projectile (fuzed) Expelling charges 76mm antipersonnel HE 40mm anti-aircraft HE 75mm shrapnel HE

Notes: (a) Density based on sampling data for Sector 3A.

(b) Density based on sampling data for Sector 3B.

HE = high explosive

mm = millimeter

OE = ordnance and explosives

Source: Final Former Benicia Arsenal EE/CA Report, 1998.

3.1 Site Description

For quantity distance (Q-D) purposes, 60mm mortar rockets and 37mm projectiles have been identified as the most probable munition (MPM) for the North and South Valleys, respectively, of the Project Site. The MPM is the round with the greatest fragment distance that can reasonably be expected to exist in any particular OE area. For each area of the Project Site, the MPM has been chosen based upon both historical and sampling data. Using the MPM for each area, the Minimum Separation Distance (MSD) has been calculated by USACE, as well as the 1/600 distance for each area. The MPMs, MSDs, and 1/600 Distances for the Project Site are listed in Table C-4. If, during the course of actual removal, it is determined that a different MPM is appropriate, then the MSD and Q-D arcs shall be determined and an amendment to the explosive safety submission shall be submitted for approval. Until the amendment is approved, the specified default distances in DOD 6055.9-STD, chapter 5, Table C5.T.1 will be used. USACE recommendations and calculations are provided in Appendix A. Procedures for the use of the 1/600 distances are discussed in Section 6.0 of this submission.

Table C-4. Tourtelot Remediation Project Site MPM, MSD, and 1/600 Distance

Project Area	MPM	MSD	1/600 Distance
North Valley	60mm mortar	1,080 feet	200 feet
South Valley	37mm projectile	1,181 feet	200 feet

mm = millimeter

MPM = Most Probable Munition

MSD = Minimum Separation Distance

3.2 Maximum Credible Event

TNT-affected soils with TNT concentrations equal to or greater than 10 percent are present in portions of the unvegetated portions of the TNT Strips situated on the north slope of the North Valley. The TNT Strips soil analytical results are shown

on Figures C-6, C-7, and C-8. An MSD of 412 feet has been calculated based on blast distance calculations derived from the potential net explosive weight of TNT in the soil. (Net explosive weight of TNT in soil = [soil volume x soil weight x percent TNT in soil]^{1/3}. The maximum TNT concentration at the site was 38 percent. Based on sample results, a radius of 2 feet and depth of 2 feet was used to calculate the soil volume. Based on these assumptions, the maximum credible event (MCE) is 10.3 pounds (i.e., maximum amount of TNT in soil). This calculation is based on the procedures included in *Ammunition and Explosive Safety Standards*, Department of the Army Pamphlet PAM 385-64. The calculation is provided in Appendix A.

4.0 START DATE

The projected start date is November 2001.

5.0 FROST LINE

Based upon data collected at the Project Site and presented in the draft final Tourtelot Cleanup RI/FS Report, the frost penetration depth for the Project Site is 0 inches.

6.0 CLEARANCE TECHNIQUES

This paragraph describes the techniques to be used to detect, recover, and destroy OE. These techniques will be implemented in accordance with the Tourtelot Project Site OE RDD.

6.1 Capabilities and Limitations of the Detection Method

An equipment performance verification test plot will be constructed and used to (1) determine the operational limitations of the selected geophysical methods to be used at the Project Site, and (2) define the remedial design depth criteria. The test plot will be used to verify the performance of electromagnetic (EM) instruments that will be deployed on the Project Site. Magnetometer systems have been excluded from consideration based on local geology and topography, and because the Project Site, like all demolition sites, possesses the potential to contain a significant population of nonferrous OE that cannot be detected with magnetometry systems.

The equipment test plot data will be used to generate site-specific detection performance curves. The curves will be used to determine the reliable depth at which the smallest MPM (37mm) will be detected below ground surface. This detection depth will be the design criteria for the remedial action.

6.2 Site Control During Ordnance and Explosives Operations

A fence has been installed to limit public access to the Project Site. A main access point to the Project Site has been established at the corner of McCall Drive on the western approach to Panorama Drive, which is controlled by manned security guards. Two secondary access gates are available. One

access gate is across McAllister Drive where it crosses Rose Drive. This gate is visible from the guard shack at the main access point. The second, an existing gate at the end of Kearney Street, will also be used. The Kearney Street gate will be used only by remediation personnel and will remain locked at all times. Access to the North Valley may be gained through private property bordering the Project Site on the east end of the North Valley (Figure C-9A).

Signs have been attached at 200-foot intervals on the fencing along the north, east, and south portions of the Project Site boundaries, except along the fence on Rose Drive and Panorama Drive, where signs have been placed on stakes behind the fence. These signs read "Keep Out, Former Military Property, Hazardous Conditions May be Present" in English and Spanish. Signs have also been placed every 100 feet along the perimeter fence around the TNT Strips. These signs read: "Caution: Hazardous Substances Area, Unauthorized Persons Keep Out, Cal. EPA, DTSC – (916) 255-3545" in English and Spanish.

Visitors will be required to attend a safety briefing, sign visitor logs, and be escorted on site. Site-specific training will be conducted for all personnel at the beginning of the project and prior to commencing fieldwork. As new personnel arrive at the site, they will be provided site-specific training prior to commencing fieldwork.

The 1/600 distance (200 feet) will be implemented when performing any subsurface excavations and intrusive OE investigations to keep the community and remediation personnel not directly involved with OE detection and removal activities away from hazardous operations. Because of the proximity of residences to the remediation area, a clearly marked security boundary around each area within the public area bordering the Project Site will be established no later than 8:30 a.m. on the days that withdrawal of residents within the 1/600 distance is required. Roads will be blocked using traffic barricades. Between road access points, the boundary will be marked, as necessary, using yellow caution tape and signs. The marked security boundary will be removed as quickly as possible after completion of the intrusive work on the Project Site, but no later than 5:00 p.m.

A voluntary separation distance will be established for all residents living within the maximum fragmentation distance of the MPM (37mm HE projectile [1,181 feet] or 60mm mortar, [1,080 feet]). Residents, businesses, and schools within the voluntary separation distance will be notified of the OE remediation activities that are taking place on the Project Site and the risks associated with the work. Notification will be made approximately 60 days prior to clearance activities and will be followed with a second notice approximately 10 days prior to clearance.

6.3 Surface Preparation

The Project Site will be cleared of vegetation to a height of 6 inches or less. If a surface OE or potential OE item is discovered during vegetation removal, the item will be clearly marked for avoidance and will be reported to the Senior UXO Supervisor (SUXOS) and the Project Manager for disposal as soon as they are discovered.

1
2 Interior fencing will be removed and disposed of to facilitate unobstructed
3 access within the Project Site. Outer boundary and security fencing will be
4 temporarily removed and reinstalled, as necessary, to allow geophysical
5 mapping crews to map at the boundaries without interference from the fencing.
6 Semipermanent markers (36-inch survey stakes) will be installed such that the
7 entire search area is covered with a 100-foot by 100-foot reference grid mesh.
8

9 Thirteen soil/debris stockpiles are present on the Project Site. Construction
10 debris will be inspected by UXO Technicians to ensure that it is free of OE;
11 nonhazardous construction debris will be loaded onto trucks and hauled off site.
12 Stockpiled soil on the Project Site will be geophysically scanned, anomaly
13 locations will be intrusively explored, and the OE and OE scrap will be removed
14 and disposed of as specified in Sections 6.8, 6.9, and 6.11.
15

16 **6.4 Surface Clearance**

17

18 UXO crews will clear each grid of any surface OE, OE scrap, or metallic debris,
19 systematically sweeping the area using a 5-foot separation distance and visually
20 inspecting the ground 2.5 feet to either side of each individual.
21

22 Hand-held all-metals detector will be used as an aid in locating surface debris,
23 and differentially GPS units will be used to record the track of the sweep teams
24 and for marking the surface location of OE items during the surface clearance.
25 OE encountered during the surface search will be reported to the SUXOS. OE
26 and potential items will be flagged for disposal operations. All OE, OE scrap,
27 and metallic debris that could impact subsurface detection and mapping of
28 potential OE sources will be removed.
29

30 To complete the surface clearance in the east (narrower) portion of the South
31 Valley wetlands, the area must be dewatered. This will be accomplished
32 through use of temporary dams with the water being pumped around the area to
33 be surface cleared.
34

35 **6.5 Subsurface Geophysical Survey**

36

37 The entire surface area (approximately 220 acres) of the Project Site will be
38 geophysically mapped using a vehicle-towed MTADS or a MPA MTADS to identify
39 the subsurface locations of potential OE. Complete survey coverage will be obtained
40 by ensuring overlap of the MTADS (and MPA MTADS) footprint through control of line
41 spacings. Survey precision will be controlled by requiring replication

of a standard geophysical response. GPS positional data will also meet a specified tolerance for replication of position over fixed, known points at the Project Site.

Where the vehicle-towed MTADS cannot be deployed, an MPA MTADS instrument will be used.

The wetlands areas will be divided into sections for geophysical survey operations. In areas where the wetlands are narrower (e.g., the east part of the valley), temporary wooden structures may be placed across the wetlands area to allow the geophysical crew to use the vehicle-towed MTADS to locate anomalies within the wetlands. In the wider areas of the wetlands (e.g., the west part of the valley) where access by the vehicle-towed MTADS would be problematic, an MPA MTADS (man-towed or raft-mounted) will be used. If testing to verify the effectiveness of floating the instruments shows that the method is not effective for detection of surface and subsurface anomalies, then these wetlands will be dewatered and a surface clearance will be accomplished before conducting the subsurface geophysical survey.

6.6 Subsurface Anomaly Excavation and Identification for Point and Areawide Clearance

Point clearance activities will be conducted across the entire Project Site to intrusively investigate all anomaly locations identified during the geophysical mapping to identify the anomaly source, as described in the following procedures. In the unlikely event that an accidental detonation or other emergency occurs, the emergency contingency plan in the OE SSHP will be followed. The Site Safety Officer (SSO) will be the primary contact and coordinator of all emergency activities.

- Anomaly locations will be recovered using an RTK GPS capable of submeter accuracy.
- Data describing the anomaly sources discovered during the intrusive investigation process will be recorded and input into the site Geographic Information System (GIS) (database) for consideration in areawide clearance activities. Recorded data will include size, estimated weight, orientation, depth below ground surface, and description of the item excavated.
- Potential OE items will be handled as OE by the OE clearance crew, and potential OE and OE items will be left in place and flagged for further inspection by the demolition team.
- After the recovered items have been removed, the entire site will be scanned a second time for quality control (QC), as described in Section 6.10,

After removal of debris from the stockpiles, the stockpiles will be graded flat to facilitate geophysical scanning and removal of anomalies. Fill soils are present at the Project Site in Unit D-1 and the bottom of the North Valley. Stockpile and fill soils will be mapped with MPA MTADS or MTADS, and the anomalies will be removed. The cleared soil will be excavated to a depth of 6 inches less than the

1 reliable depth of detection for the geophysical instrument. The process will be
2 repeated until the excavation encounters the bottom of the stockpile or fill
3 material.
4

5 Based upon the density of the anomalies within the South Valley wetlands, one
6 of two methods may be used to recover, investigate, and remove anomalies.
7 Water depth in the wetlands ranges from less than 6 inches to approximately 3
8 feet.
9

- 10 • The first method may require dewatering segments of the wetlands
11 and would be used in areas with high anomaly density. It is
12 anticipated that this method would be required in the east portion of
13 the wetlands adjacent to suspected Demolition Site #1, and
14 Demolition Site #3, and the Flare Site. This would be accomplished
15 through use of temporary dams with the water being pumped
16 around the area to be point cleared. Once the anomalies are
17 recovered, the source will be removed, the area will be remapped,
18 and the process repeated until two complete mapping and anomaly
19 removal cycles have been completed. Segments will be established
20 with a minimum of a 10-foot overlap to ensure detection and
21 removal of anomalies.
22
- 23 • The second method involves use of a rigid, reusable sediment
24 barrier that is approximately 8 feet in diameter. The barrier will be
25 placed around the anomaly location, and the inside will be
26 dewatered. This method will be used in areas with a low density of
27 anomalies; it is anticipated to be used in the west portion of the
28 South Valley wetlands.
29

30 After completion of point clearance and prior to the start of the additional OE
31 clearance, an evaluation of the distribution of OE and OE scrap will be
32 performed to assess if it is suspected that soils in an area below the depth of the
33 geophysical scan contain OE. The goals of the evaluation will include:
34

- 35 • Identifying the patterns of OE and OE scrap items found at the
36 Project Site
37
- 38 • Assessing whether areas where OE items were found are or are not
39 considered to be “kicked out” of the demolition site(s)
40
- 41 • Defining the extent of the OE kick-out zone
42
- 43 • Defining other areas where OE was identified that is not associated
44 with the kick-out zone.
45
- 46 • The project will evaluate if soils previously excavated and
47 transported off site contain OE.
48

49 A final site conceptual model will be developed that is based on data collected
50 during the point clearance phase of this OE investigation and remediation and
the work at the former Benicia Arsenal that began in May 2001.

Based on these data, DTSC, USACE, the remediation contractor, and Granite will establish kick-out radii for OE and OE scrap, defined as the farthest distance to an item thought to be kicked out in the pattern from the center of the nearest identified demolition site. The OE kick-out radii will incorporate a determination as to how far out an OE item must be beyond the pattern of OE finds to determine that the item is an outlier. If an item is found to be an outlier and meets the criteria for further OE clearance (areawide clearance), then a buffer zone of a 200-foot radius beyond the location of the OE item will be established.

Areawide clearance will be conducted on the Project Site to complete OE remediation. Areawide clearance is the removal of soil that is suspected of containing OE below the depth of the previous OE cleanup activity or that is associated with an outlier and is within a future residential area. The areawide clearance will continue until two consecutive lifts of soil that do not contain OE or OE scrap are removed and no deeper anomalies are detected. A lift of soil ranges from 12 to 18 inches in thickness.

Soil within grids requiring areawide clearance, as determined by the final site conceptual model, will be scanned, point cleared, excavated, and placed in the North Valley as engineered fill. Soil will be excavated in lifts no greater than 6 inches less than the reliable depth established for digital geophysical surveys. After the first lift is removed, the excavated surface will be scanned using the procedures for real-time surveys and any anomalies will be point cleared. The excavated soil will be scanned in 8-inch lifts as it is being placed as engineered fill in the North Valley. If no OE or OE scrap are found under the excavated surface or within the soil as it is placed in the North Valley, the lift will be considered a clear lift. If two consecutive clear lifts are found, the remaining soil will be removed by grading and deposited in the North Valley as engineered fill without scanning. If OE or OE scrap is found in a lift, then the scanning and excavation will continue until two consecutive clear lifts are found or bedrock is encountered.

6.7 Operations in Populated/Sensitive Areas

OE remediation activities conducted under this submission will be performed in close proximity to populated areas in both sectors (North Valley Sector and South Valley Sector). The populated areas include roadways, residences, and businesses. These populated areas lie within the MSD for the MPM in each sector. Based on the justifications and approval provided in Appendix A, the remediation contractor will use the 1/600 distance as the MSD for each sector and will clear all grids up to the 1/600 distance based on the MPM for each sector. Any grids that require clearance within the 1/600 distance will only be cleared after the withdrawal of all occupied buildings has been conducted. Withdrawals will be coordinated by the remediation contractor with the assistance of public officials and law enforcement.

6.8 Engineering Controls

Engineering controls for demolition of OE will be used as delineated in the CEHNC document *Use of Sand Bags for Mitigation of Fragmentation and Blast Effects due to Intentional Detonation of Munitions* HNC-ED-CS-S 98-7 and approved by the Department of Defense Explosives Safety Board (DDESB) on February 23, 1999. These controls will be applied as necessary to mitigate fragmentation and blast hazards created during open detonation demolition operations, which will be required on site in the event a blast chamber cannot be used (e.g., OE items that are too large to be safely destroyed in the chamber, items that are not safe to move). Additionally, tamping may be used to control fragmentation blast and noise. Tamping will be conducted in accordance with guidance provided by the CEHNC using the *Buried Explosion Module (BEM), A Method for Determining the Effects of Detonation of a Buried Munition* HNC-ED-CS-S 97-7, Rev. 1, and approved by DDESB on November 3, 1998. The UXO Safety Officer (UXOSO) and CEHNC On-site Safety Specialist (OSS) will coordinate and determine the appropriate engineering controls that will be needed during demolition operations. A miniature open front barricade will also be available and may be used for excavation of anomalies (*Miniature Open Front Barricade*, HNC-ED-CS-S 98-8, and approved by DDESB on February 28, 1999).

6.9 Demolition Operations

UXO personnel will dispose of OE that cannot be moved on a daily basis. OE that can be moved will be consolidated in magazines and disposed of at the end of each work week in a self-contained blast chamber that will be deployed and set up on the Project Site. If OE items exceed the capacity (net explosive weight) of the on-site blast chamber, they will be detonated at a designated on-site demolition area. If an OE item cannot be moved, it will be blown in place after authorization has been received to conduct the procedure from DTSC and USACE.

At a minimum, the OE disposal operations team will consist of three UXO-qualified individuals, including the SSO, UXO Demolition Supervisor, and a UXO Technician. These operations will be performed under the direction and supervision of the SUXOS. The SSO and OSS will monitor compliance with the safety measures contained in the OE Site-Specific Safety and Health Plan (SSHP). In the event of noncompliance, the SSO will stop or suspend operations until the operations are in compliance. Demolition activities are inherently hazardous and require strict adherence to approved safety and operational procedures. Violations of procedures may result in immediate removal of the violating party from this project. A contingency plan will be implemented for on-site detonation at a constructed demolition site of safe-to-move OE items that are too large to be destroyed in the blast chamber. The designated demolition site will be cleared of any potential OE prior to construction. After explosive disposal of OE, the open demolition site will be tested and treated for toxic substances in accordance with the non-OE RDD. The sites used for BIP demolition of OE will be left unearthed and positively marked for follow-on testing in accordance with the non-OE RDD.

1 All open demolition operations will be conducted by safely detonating OE items
2 using the Standard Operating Procedures for OE Demolition/Disposal
3 Operations (Appendix B); and Technical Manual (TM) 60A-1-1-31; CEHNC
4 *Safety Concepts and Basic Considerations for Unexploded Ordnance (UXO)*,
5 dated May 22, 2000; and CEHNC-approved engineering controls, as specified in
6 HNC-ED-CS-S-98-7, August 1998, to control/minimize hazards of blast and
7 fragmentation. In all cases, disposal operations will be performed between
8 9:00 a.m. and 3:00 p.m., Monday through Friday, and will not be conducted
9 during days of low cloud cover or temperature inversions, which could amplify
10 the noise associated with detonations and adversely affect local residences.

11
12 After approval from DTSC and USACE, authority to initiate the demolition shot
13 setup and the detonation will rest solely with the SUXOS. Prior to authorizing
14 the detonation of explosive charges, the SUXOS is responsible for ensuring that
15 all personnel have been evacuated from the for sandbag enclosures, all
16 personnel have been accounted for, all pertinent parties have been notified of
17 an impending demolition shot, and the area is secure. The SUXOS will notify
18 the local fire department of the location and approximate times prior to
19 detonation.

20
21 Upon completion of demolition operations, the demolition team will visually
22 inspect each demolition shot. Upon completion of this inspection and assuming
23 there are no residual hazards, the SUXOS will authorize the resumption of site
24 operations.

25 26 **6.10 Quality Assurance/Quality Control**

27
28 Pass/fail detection performance criteria for the geophysical systems to be used
29 will be detection of the smallest MPM to the system-reliable depth. This will be
30 tested and verified for each system deployed prior to its use at the Project Site.
31 A QC check of the detection and removal efficiency of the point clearance
32 process will be performed by remapping the entire site along parallel transects,
33 recovering and investigating any newly discovered anomalies, and categorizing
34 the anomaly sources. Any new anomaly locations found during the remapping
35 will then be excavated as described above. Discovery of any OE or OE-like
36 items during the second round of intrusive investigations will require remapping
37 and investigation of the failed grid and the eight surrounding grids. OE-like
38 items are defined as an item with a similar geophysical signature as an OE item.
39 After the mapping/intrusive investigation activities are complete, a QC
40 evaluation will be performed and documented. An independent quality
41 assurance (QA) contractor will oversee all OE operations. The QA contractor
42 will check conformance with the QC Plan by the OE remediation contractor.

43 44 **6.11 Ordnance and Explosives Scrap Inspection/Disposal**

45
46 All non-OE scrap and OE scrap, including inert OE items, will be inspected by
47 UXO technicians in accordance with Chapter 4.0 of the OE RDD. All non-OE
48 scrap, OE scrap, and inert OE items will be segregated as it is inspected.

Prior to moving the OE scrap to a secure central collection it will be reinspected by the demolition team and transported to the secure storage.

The SUXOS and the UXO QC Supervisor will perform a final inspection of the OE scrap at the central collection point, place it in secure locked storage containers, and certify it to be free of any explosive hazard. The SUXOS and UXO QC Supervisor will then sign and annotate a Release/Receipt Document with the following statement: "I certify that the property listed hereon has been inspected by me and, to the best of my knowledge and belief, contains no items of a dangerous nature."

Following the final inspection, the containerized OE scrap will be picked up and delivered to a local scrap dealer for recycling.

6.12 TNT-Affected Soils

Homogenization of TNT-affected soil will be a two-step process. If there is no evidence of metallic OE or OE scrap in the TNT Strips and after the strip has been adequately watered to reduce the explosive potential, the first step will be for a 2-foot layer to be completely turned using a narrow-width deep plow pulled behind a 4-wheel drive, rubber-tired tractor (if OE/OE scrap are present, the thickness of the first layer will be 6 inches less than the reliable detection depth of the instrumentation used to clear the site). The goal of this plowing step is to bring the soil at the bottom of the layer to the top surface. The total number of passes of this plowing process for any homogenization zone will be dependent on the actual subsurface conditions encountered in the field, but will likely require multiple passes.

The tractor planned to pull the plow and disc implements will have a fully enclosed cab that is air conditioned. The tractor doors and windows will be closed and latched during the homogenization operations. The back window of the tractor or other windows in a direct path of potential soil particles will be equipped with a 4-ply Lexan plate (Underwriters Laboratory listed 752PSA [Level 3]) of an approximate 1.3-inch thickness. The side and front windows not in a direct path of potential fragments will be equipped with Lexan CTG plate (in accordance with ANSI Z87.1989) of approximate 1/8-inch thickness.

Only essential personnel will be inside the MSD during the homogenization operations: the equipment operator in the excavation zone and the air monitoring technician. The equipment operator and the air monitoring person will wear protective vests and helmets during all homogenization operations.

After the homogenization is complete, field screening tests will be performed for the 2-foot soil layer to verify that TNT concentrations are below 10 percent.

7.0 ALTERNATIVE TECHNIQUES

No other disposal techniques are anticipated for this OE removal action.

8.0 OFF-SITE DESTRUCTION

No off-site destruction of recovered OE is anticipated for this OE removal action. All demolition operations will be conducted in accordance with Section 6.9.

9.0 TECHNICAL SUPPORT

All on-site UXO personnel will meet the training/experience requirements required by USACE, Sacramento District.

No chemical warfare material (CWM) is suspected at the Project Site. Additionally, the OE remediation contractor personnel will positively identify all OE items prior to movement or disposal. If suspected CWM is found, or if an OE item cannot be positively identified, the Sacramento District OSS will request military support from the Technical Escort Unit or the 787th Ordnance Company, Moffit Field, California.

10.0 LAND USE RESTRICTIONS

The City of Benicia Zoning Ordinance establishes permitted land uses for specific properties within the City. Land uses designated for the Project Site are single-family residential, general open space, and parks. The Unit D-1 portion of the site, which is south of the South Valley, has been graded for residential development, with streets and utilities installed. One unoccupied house has been constructed in the Unit D-1 area. The Ridge, a majority of the North Valley, and Unit D-1 areas are planned as a residential development. The South Valley will remain as open space (Figure C-9). Institutional controls will be applied to portions of the Project Site through a Covenant to Restrict Use of Property recorded with Solano County. The institutional controls will affect the paved streets and sidewalks in Unit D-1 and the open space parcels in the North and South Valleys and on the McAllister Drive Land Bridge. The restrictions will permanently apply to the affected areas and will restrict any excavation or other activities that would penetrate the ground. Any planned excavation in the this area will require that notice be provided to the City of Benicia, California Department of Toxic Substance Control (DTSC), and the USACE, Sacramento District, and that the activities would only be conducted using support by UXO technicians. The restrictions will also prevent the owners of the affected areas from obtaining any change in the land use designation or zoning for the North and South Valley open space parcels without written approval of DTSC.

11.0 PUBLIC INVOLVEMENT

The adjoining community and other interested parties will be informed of the activities conducted at the Project Site, in accordance with the Public Participation Plan (PPP) and the final Minimum Separation Area (MSA) Notification and Implementation Plan (MSAP) that has been prepared for the site. Public meetings will be held and fact sheets prepared as major milestones in the OE removal are

achieved, in accordance with the PPP for the Project Site (Granite Management Corporation, September 1999).

The process for providing information to the community, including public meetings, is described in the MSAP. Prior to initiation of any proposed activities, businesses and residents near the Project Site will be informed of the proposed project activities. This notification will include information on a 24-hour public information telephone line that will be established and maintained to provide updated information on project activities, including information on planned or accidental detonations of OE, if applicable. The telephone line will also allow residents and businesses to express concerns or ask questions regarding project activities. All appropriate city, county, state, and federal officials will also be kept informed by direct mail and telephone notification.

12.0 QUANTITY DISTANCE

MSDs and 1/600 distance restrictions from the OE areas to non-project personnel will be applied during all intrusive OE investigation and removal operations being conducted. The MSDs and 1/600 distance identified by the CEHNC for each sector are presented in Table C-4 of this document. During anomaly investigations where an unintentional detonation may occur, the 1/600 distances in Table C-4 will be applied. Preliminary site work (e.g., surveying, laying out grids, surface clearance of construction debris, brush clearance, surface clearance of non OE and OE scrap, geophysical mapping) does not require the establishment of an MSD for Q-D purposes. At any time that an OE item is unexpectedly discovered during a site preparation, activity work will stop and the 1/600 distance will be immediately enforced. For intentional detonations, an engineering control such as those described in Section 6.8 of this document will be used. The MSDs for sandbag enclosures for the MPMs (37mm and 60mm) as presented in the MSD calculation sheets in Appendix A will be used. Project personnel are defined as those on-site contractor and DOD personnel required to participate in the OE removal. All other personnel are non-project related and are not authorized to be within the 1/600 distance while work is in progress.

For the OE remediation sites addressed in this ESS, the outer boundaries of the MSD arcs and 1/600 distance arcs shown on the site map were measured from the outer boundaries of each sector (Figure C-10). The team separation distance at each site will be 200 feet, which is greater than the K50 over pressure for the MPMs listed.

12.1 Ordnance and Explosives Area(s)

The 1/600 distance must be maintained during the excavation of OE-related anomalies. The MSDs for sandbag enclosures for the MPMs as presented in the MSD calculation sheets in Appendix A will be used for the disposal of OE. An MSD of 412 feet must be maintained for homogenization of TNT-affected soils with a TNT concentration of 10 percent or more by weight. Only OE excavation crews, geophysical crews, and other support crews that are essential to the OE remediation on the Project Site will be allowed within the 1/600

1 distance. However, a safe separation distance of not less than 200 feet must be
2 maintained at all times between the various work crews.

3 4 **12.2 Magazines**

5
6 There are two approved BATF Type 2 outdoor storage magazines at the Project
7 Site (see Figure C-9). These will be used by the remediation contractor during
8 this project. The OE remediation contractor will ensure that the proper
9 permitting is maintained throughout the project, and that magazine criteria and
10 quantity distance requirements established in ATF - Explosives Law and
11 Regulations ATF P 5400.7 are maintained. The on-site magazines are
12 barricaded and have a separation distance from each other of more than 200
13 feet and are over 600 feet from the closest inhabited building. Under the
14 requirements of ATF P 5400.7 the storage of up to 2,500 pounds of explosive
15 materials could be authorized in each magazine. As this site is located within
16 the city limits, near populated areas, and based on the storage of OE items vice
17 explosives materials, the remediation contractor will set a limit of not more than
18 50 pounds per magazine to equal not more than 100 pounds Net Explosive
19 Weight (NEW) on site at any given time. Both of these magazines are
20 designated as a hazard division 1.1. The magazines are inside a fenced area
21 and are patrolled by a professional security force 24 hours per day, 7 days per
22 week.

23
24 Explosives to be used for demolition will be provided daily as required and will
25 be delivered to the site in day boxes. Under no circumstances will explosive
26 demolition materials be stored on site.

27 28 **12.3 Planned or Established Demolition Areas**

29
30 If safe-to-move OE items that are too large to be destroyed in the blast chamber
31 are discovered, a demolition site will be constructed at the site of the former
32 Howitzer Test Facility to allow safe on-site detonation (see Figure C-9).
33 Construction of the demolition site will include a pliable liner under 3 feet of
34 native soil. A berm will be constructed around the area. A hose will be placed
35 at the bottom of the demolition site, leading out of the demolition area, and
36 capped. This hose will be used to pump any water that may collect in the
37 demolition area into 55-gallon drums. A cover will be placed over the demolition
38 area when it is not in use to reduce fugitive dust and to prevent rain water from
39 entering the area. At the completion of the OE Remediation, the soils in the
40 demolition area will be tested for appropriate chemicals and, if the
41 concentrations exceed cleanup goals, the soil will be removed from the Project
42 Site. The sites used for disposal of OE and OE scrap where explosives are
43 used as the disposal method will be tested and treated for toxic substances in
44 accordance with the Non-OE Remedial Design Document. The sites used for
45 BIP demolition of OE will be left unearthened and positively marked for follow-on
46 testing.
47
48

12.4 Collection Points

Collection points are areas used to temporarily accumulate OE within a search grid pending destruction in consolidated shots. Consolidating multiple OE for in-grid consolidated shots will not be conducted at the Project Site. OE that is safe to move will be moved to the magazine area for on-site storage for disposal at the end of the work week.

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APPENDIX A

MINIMUM SEPARATION DISTANCE CALCULATIONS

APPENDIX B

STANDARD OPERATIONS PROCEDURES DEMOLITION/DISPOSAL OPERATIONS